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IL-0408-23

RCRA MONITORING PLAN

Cabot Corporation

Tuscola, Illinois

RECEIVED

AUG 30 1982

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STATE OF ILLINOIS

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298903

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Consulting Groundwater Geologists

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INTRODUCTION

Bruce S. Yare and Associates, Inc. were retained by the Cabot Corporation to design a RCRA ground-water monitoring plan for the hazardous waste management facility at the Tuscola, Illinois plant (Figure 1). Regionally, ground-water conditions are suitable for hazardous waste disposal because of the thick, low-permeability glacial tills that blanket bedrock. The plant, operating since 1958, primarily produces fumed silica but also sells hydrochloric acid, a process byproduct.

Cabot's hazardous waste management facility is a two-cell impoundment classified as hazardous on the basis of corrosivity only. The RCRA impoundment, excavated in low-permeability glacial till, acts as a holding basin for waste water containing one to four percent hydrochloric acid prior to its disposal in a deep injection well. This waste disposal system has operated since 1967. Before installation of the injection well, acidic waste water was held in a number of different pits located east and southeast of the RCRA impoundment.

This ground-water monitoring plan is intended to satisfy Part 265, Subpart F, Sections 265.91 through 265.94 of the "Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities".

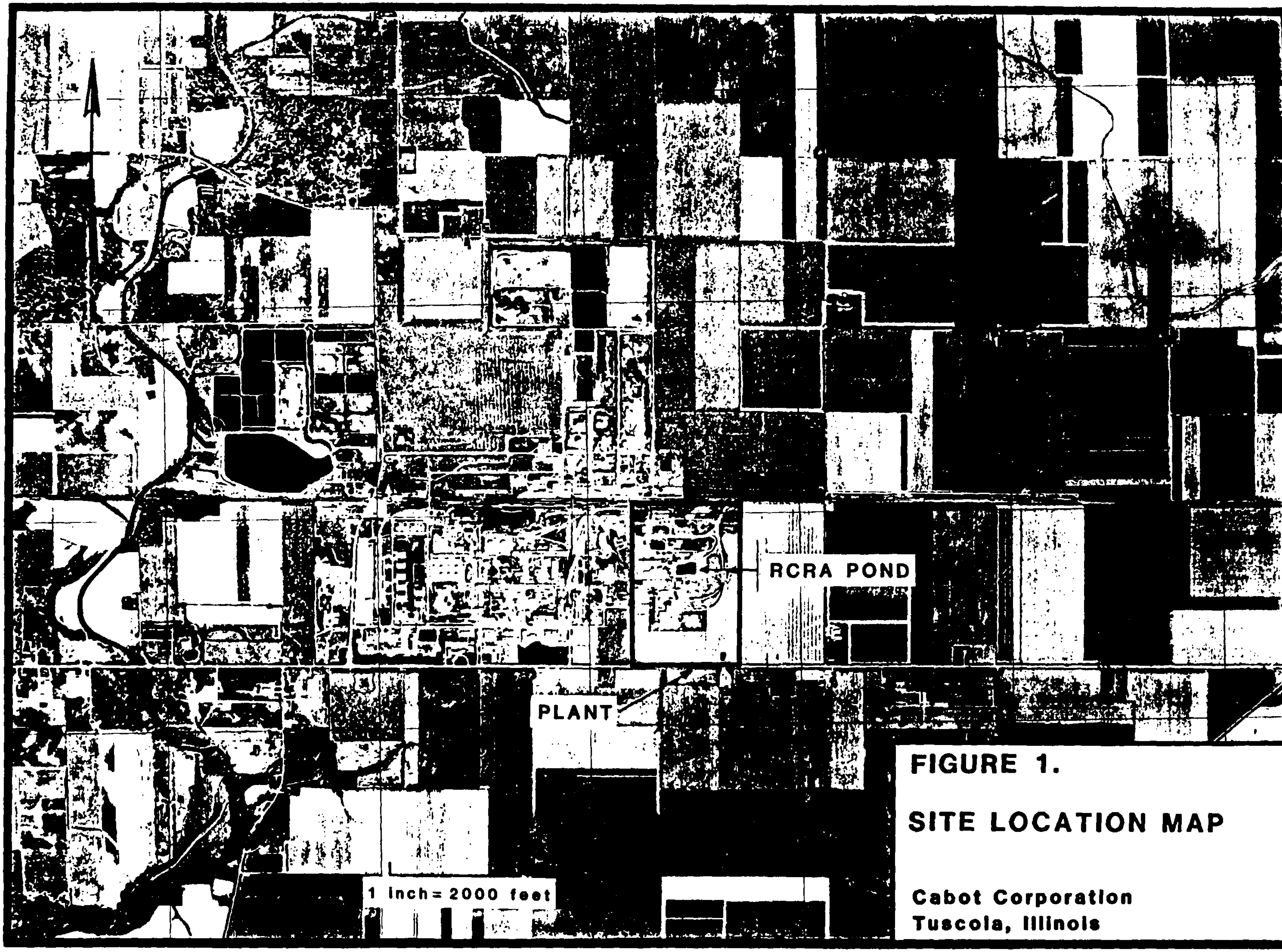

FIGURE 1.

SITE LOCATION MAP

Cabot Corporation
Tuscola, Illinois

SITE HYDROGEOLOGY

The plant is located in a region of Illinois generally considered suitable for hazardous waste disposal (Cartwright and others, 1981). Several hundred feet of low-permeability glacial drift, consisting mainly of silt and clay, overlie a shale bedrock which is not normally used as a drinking water source. Limited amounts of water can be obtained from thin, isolated, lenticular sand lenses in the drift but the occurrence of these sand lenses is irregular and difficult to predict.

Soils at the site are low-permeability glacial till composed primarily of clay and silt with thin, isolated, lenticular sand lenses. Physical characteristics of the soils are given in Appendix 1. The tills are classified as CL soils (USCS) with a moisture content of 14 to 26 percent and a dry density of 98.5 to 122.0 pounds per cubic foot. Vertical permeability determined from laboratory tests on representative soil samples averages 8.25×10^{-9} cm/sec and ranges from 1.1×10^{-8} to 7.5×10^{-9} cm/sec. Falling head tests conducted on monitoring wells MW-3 and 4 indicate the horizontal permeability of the soils at the site ranges from 5.8×10^{-5} to 6.6×10^{-5} cm/sec (assuming $Kv = Kh$). The large difference between laboratory and field permeability is probably due to horizontal flow in permeable sand lenses or fracture zones in till.

A hazardous waste management facility in this region could adversely effect important ground-water resources if located over a buried valley aquifer or a permeable dolomite aquifer along the LaSalle Anticline. There is no buried valley aquifer in the vicinity of the site (Selkregg and Kempton, 1958 and Visocky and Schicht, 1969). The dolomite aquifers associated with the LaSalle Anticline are more than two miles east of the site (Bristol and Prescott, 1968).

MONITORING PLAN

Monitoring System

Regional ground-water flow direction at the site was not known so the monitoring wells were installed around the facility rather than on the anticipated downgradient side. In order to detect the lateral spread of poor-quality water, monitoring wells were installed away from the limit of the waste management facility (Figure 2). Since the impoundment is elevated above grade, any leakage would create a recharge mound with radial flow in all directions away from the facility. The installed monitoring wells are located to detect such leakage.

Roadways, buildings, process areas, pipe lines, power lines, etc. around the RCRA impoundment prevented the installation of wells immediately adjacent to the facility.

Four 2-inch diameter wells were installed around the RCRA pond: one upgradient well (MW-1) and three downgradient wells (MW-2, 3 and 4). These wells, installed at a depth of 30 feet, consist of 20 feet of machine-slotted PVC well screen and 10 to 15 feet of PVC riser pipe made up with flush threaded joints (Appendices 2 and 3). To avoid sample contamination, PVC glue and cleaner were not used in well construction. After backfilling

Yare and Associates, Inc.

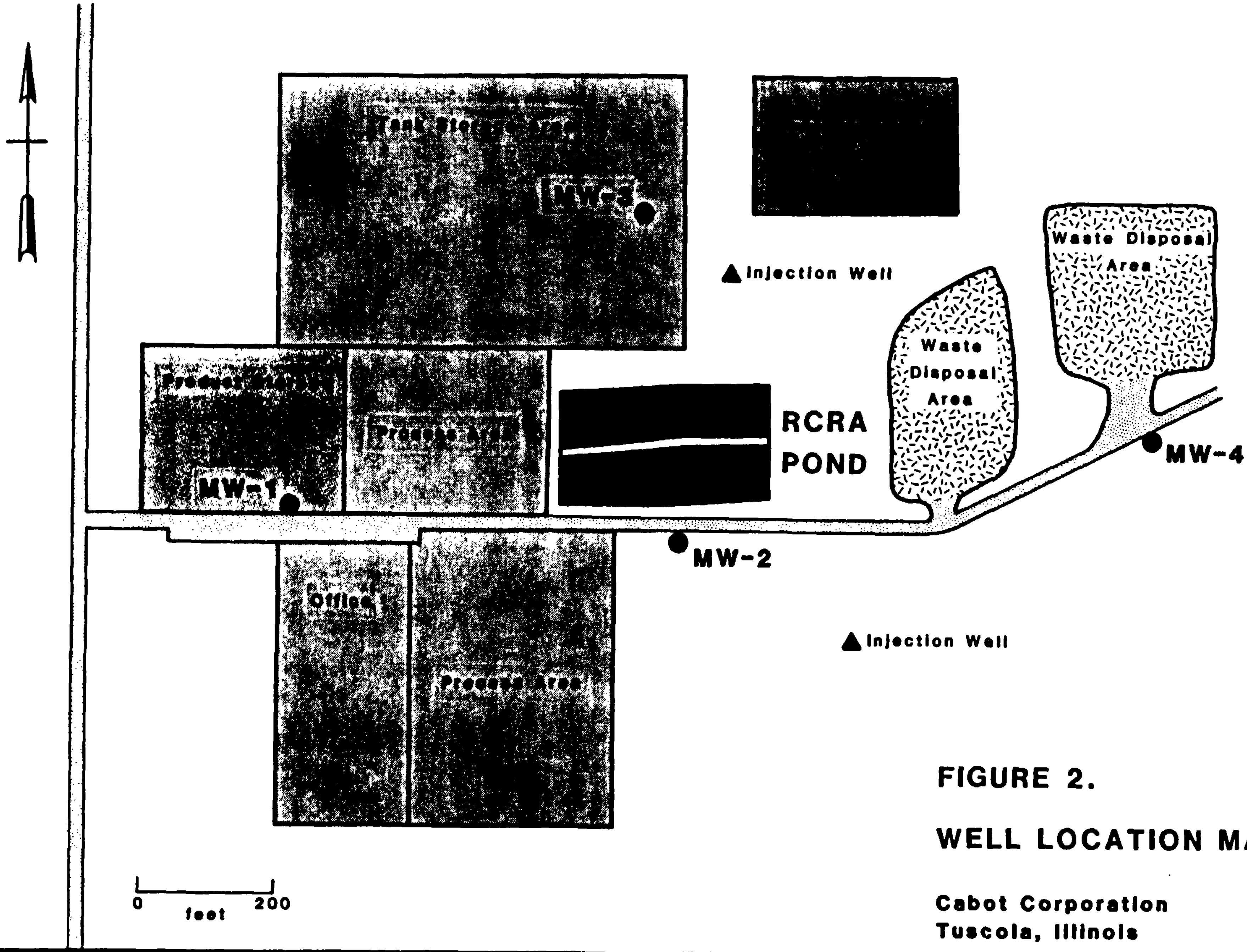

FIGURE 2.

WELL LOCATION MAP

Cabot Corporation
Tuscola, Illinois

the screened interval with clean quartz sand, the annulus was filled to grade with cement/bentonite grout.

Sampling Procedures

Water-quality samples will be collected quarterly for one year from each of the monitoring wells. The wells will be purged by removing at least one well volume with either a bailer, peristaltic pump, pitcher pump, airlift pump or some other suitable purging device. The purging method used will depend on the depth to water, well yield and the potential for cross contamination by the purging equipment. If well yield is too low to sustain continuous withdrawals, the well will be pumped and/or bailed dry and sampled after the water level recovers.

Purge volumes will be determined by measuring the depth to water in each well and calculating the standing water volume with the following formula:

$$Vw = Vc(Dc - Dw)$$

Where:
- Vw = standing water volume, gal
- Vc = casing unit volume, gal/ft
- Dc = total well depth, feet
- Dw = depth to water, feet

Samples will be collected with a stainless steel bailer attached to new rope. Before each use, the bailer will be rinsed inside and out with distilled water at least four times. The bailer will then be lowered into the well, filled and dumped to waste four times before collecting a sample. Plastic and amber glass bottles of sufficient size for the required water-quality analyses will be filled on the fifth and subsequent bails.

All bottles will be prepared according to EPA protocol. Samples will be kept on ice from time of collection and hand carried to the plant laboratory where the proper preservatives, if any, will be added. Samples not run in the plant laboratory will be shipped to a commercial lab by the fastest means necessary.

Analytical Procedures

Ground-water quality samples will be analyzed in accordance with EPA 600/4-7-020, "Methods for Chemical Analysis of Water and Wastes". For a period of one year after initiation of the RCRA monitoring plan the samples will be analyzed quarterly for the parameters listed in Table 1. This will establish background concentrations of all the parameters in each of the monitoring wells. Four replicate analyses of the contaminant indicators will be run for each of the quarterly samples collected from the upgradient, background well during the first year. The arithmetic mean and variance of the background well analyses will be determined by pooling the replicate analyses after the first year of sampling.

After the first year of sampling, the drinking water parameters will not be run, the ground-water quality parameters will

Table 1. Water-Quality Parameters, RCRA Monitoring Plan. Cabot Corporation, Tuscola, Illinois.

Drinking Water Parameter	Ground-Water Quality Parameters	Contamination Indicator Parameters
Arsenic	Chloride	pH
Barium	Iron	Conductivity
Cadmium	Manganese	Total Organic Carbon
Chromium	Phenols	Total Organic Halogen
Fluoride	Sodium	
Lead	Sulfate	
Mercury		
Nitrate		
Selenium		
Silver		
Endrin		
Lindane		
Methoxychlor		
Toxaphene		
2,4-D		
2,4,5-TP Silvex		
Radium		
Gross Alpha		
Gross Beta		
Coliform Bacteria		

Notes:

1) All analyses will be run quarterly for one year

2) After the first year of sampling, the drinking water parameters will not be run, the ground-water quality parameters will be run annually and the contamination indicators will be run semi-annually.

be run annually and the contamination indicators will be run semi-annually. If no significant levels of total organic halogen are found after the first year of sampling, TOX analyses will be suspended and total organic carbon will be used to detect organic contaminants.

To insure that samples do not become contaminated during collection and shipment, organic-free water blanks will be carried during sampling and shipped with any samples sent to commercial laboratories. Duplicate samples, spiked samples and spiked blanks will be used as necessary for analytical quality assurance.

Chain of Custody Control

At the time of collection, the following information will be recorded in a bound log book: sample identification number, date and time of collection, sample source, depth to water, preservative added and the analysis to be performed. The notebook will be signed and dated by the sampler. A water-proof label will be put on each sample bottle and marked with the sample identification number and the analysis to be performed. Each bottle will be sealed immediately after sample collection and preservation.

Upon arrival at the laboratory, the sample custodian will log in the samples, recording in a bound log book the sample numbers the date and time of receipt and the condition of each sample and sample seal. Each entry will be signed and dated by the sample custodian. The samples will be stored in a locked area and distributed by the sample custodian or authorized representative to the laboratory personnel who will perform the analyses. The person receiving the samples will record the sample number, time of receipt and condition of the sample seal in a bound laboratory notebook and sign and date the entry.

The entries into the permanently bound field notebook, log notebook and analyst notebook will constitute the chain of custody record.

Statistical Analysis and Notification

When the first year background concentration sampling is finished, all subsequent samples from downgradient wells will be compared to baseline water quality as defined by the arithmetic mean and variance of the quarterly samples from the upgradient well. The statistical comparison will be done for each of the contamination indicators (pH, S.C., TOC, TOX) using the Student's t-test at a 0.01 level of significance. If this analysis shows a statistically significant increase (or pH decrease) in contamination indicator concentrations, the wells showing the increase will be resampled. The samples will be split and reanalysed.

The Regional Administrator will be notified within 7 days of confirmation of the statistically significant increase (or pH decrease) that the hazardous waste management facility may be effecting ground-water quality. Within 15 days of this notification the plan for a ground-water quality assessment program, certified by a qualified geologist or geotechnical engineer, will be submitted to the Regional Administrator. The plan will be designed to determine the concentration of contaminants in the ground-water system, the contaminant migration rate and areal extent of the contaminant plume. Number, depth and location of additional monitoring wells will be specified in the plan along with sampling, water-quality analysis and data evaluation procedures.

The ground-water quality assessment plan will be implemented as soon as technically feasible after notification. Within 15 days of completing work on the assessment program, a written report will be submitted to the Regional Administrator summarizing the results of the investigation. If there is no leakage from the RCRA impoundment, the indicator evaluation program will be reinstituted. Quarterly assessments of the concentration, rate of movement and areal extent of contaminated ground water will be initiated if there is leakage from the impoundment.

Assessment Plan Outline

The data collected during the ground-water quality assessment program, along with information from other sources, will be used to evaluate: 1) whether the impoundment is leaking and contaminants are entering the ground-water flow system, 2) the rate and extent of contaminant migration and 3) the concentration of contaminants in the ground-water system. This evaluation will consider the following:

1) regional hydrology;
2) physical characteristics of the subsurface materials encountered at the site including vertical and horizontal permeability;
3) water-bearing characteristics of subsurface materials at the site;
4) water-level elevation and ground-water gradients;
5) ground-water flow rate and direction;
6) contaminant concentrations in monitoring wells;
7) estimated extent of contaminant movement; and
8) potential for impact on the uppermost aquifer, nearby wells and surface water.

Respectfully Submitted,

Bruce S. Yare and Associates, Inc.

Bruce S. Yare

Bruce S. Yare, CPG 4436
President

REFERENCES

Bristol, H.M. and R. Prescott, 1968. Geology and Oil Production in the Tuscola Area, Illinois: Ill. Geol. Surv. Curc. 426, 18 p.

Cartwright, K. and others, 1981. Hydrogeologic Considerations in Hazardous-Waste Disposal in Illinois: Ill. Geol. Surv. Env. Geol. Notes 94, 20 p.

Selkregg, L.F. and J.P. Kempton, 1958. Groundwater Geology in East-Central Illinois: Ill. Geol. Surv. Circ. 248, 36 p.

Visocky, A.P. and R.J. Schicht, 1969. Groundwater Resources of the Buried Mahomet Bedrock Valley: Ill. Water Surv. Rept. of Inv. 62, 52 p.

APPENDIX 1

Physical Characteristics of Soil Samples

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SOIL CLASSIFICATION AND ENGINEERING PROPERTIES

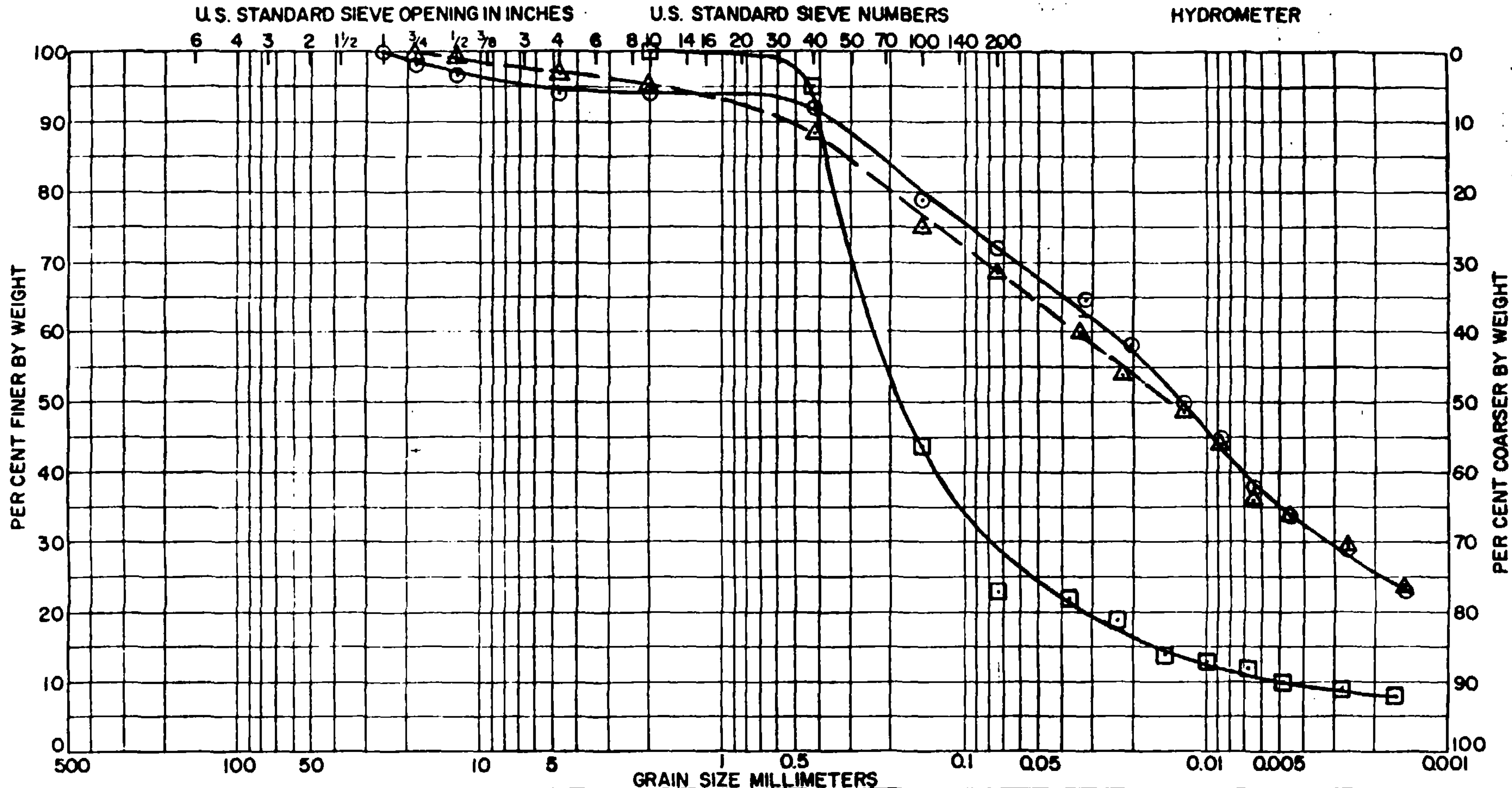
PROJECT: Observation Well Program
Cabot Corporation
Tuscola, Illinois

JOB NO. 11801

DATE: December 28, 1981

BORING/SAMPLE NO'S.	3/2	3/5	4/1	4/7	3/3
DEPTH/FT	7 - 9	19½ - 21½	4½ - 6½	29½ - 31½	@ 10½
SOIL PARTICLE SIZES					
GRAVEL; %	6	3	0	2	0
SAND; %	22	29	16	26	71
coarse %	0	2	1	1	0
medium %	6	7	2	5	6
fine %	16	20	13	20	65
FINES; %	72	68	84	71	29
silt %	46	42	52	46	21
clay %	26	26	32	25	8
PLASTICITY CHARACTERISTICS					
MOISTURE CONTENT %	16	15	26	14	--
LIQUID LIMIT	--	--	--	--	--
PLASTIC LIMIT	--	--	--	--	--
PLASTICITY INDEX	--	--	--	--	--
CLASSIFICATION					
USCS	Brown/Gray CL	Gray CL	Brown CL	Gray CL	Brown SM
USDA/AASHTO	--	--	--	--	--
ENGINEERING PROPERTIES					
UNIT DRY DENSITY; pcf	118.0	120.0	98.5	122.0	--
PERMEABILITY, k, cm/sec	$1.1x10^{-8}$	$1.0x10^{-8}$	$7.5x10^{-9}$	$4.5x10^{-9}$	$4x10^{-7}$
METHOD OF DETERMINING k	Test	Test	Test	Test	Grain Size

GRAIN SIZE DISTRIBUTION



BORING NO.	SAMPLE NO.	SYMBOL	ELEV./DEPTH	USC	DESCRIPTION	NAT. W%	LL	PL	PI
3	2	○	7'-9'	CL	Mottled brown/gray, medium plasticity silty clay, little sand, tr gravel	16	--	--	--
3	3	□	10½'	SM	Brown silty fine sand, trace clay	--	--	--	--
3	5	△	19½'-21½'	CL	Gray, medium plasticity silty clay, little sand, trace gravel	15	--	--	--

OBSERVATION WELL PROGRAM
CABOT CORPORATION
TUSCOLA, ILLINOIS

PROJ. NO. 11801

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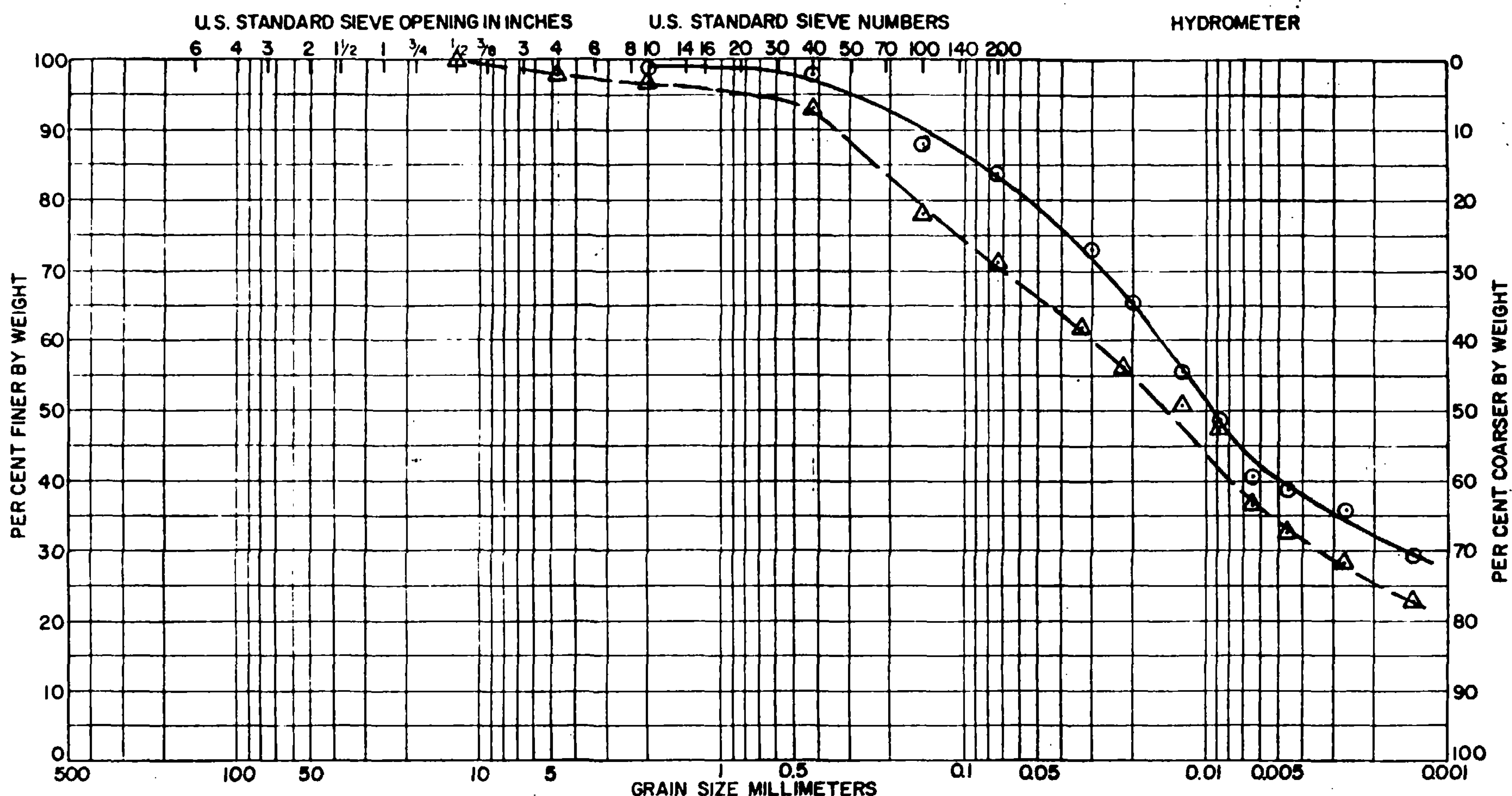
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING NO.	SAMPLE NO.	SYMBOL	ELEV./DEPTH	USC	DESCRIPTION	NAT. W%	LL	PL	PI
4	1	O	4½'-6½'	CL	Mottled gray/brown, med. to high plasticity silty clay, little sand	26	--	--	--
4	7	Δ	29½'-31½'	CL	Gray, medium plasticity silty clay, little to some sand	14	--	--	--

OBSERVATION WELL PROGRAM
CABOT CORPORATION
TUSCOLA, ILLINOIS

PROJ. NO. 11801

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SHAFFER, KRIMMEL, SILVER & ASSOCIATES, INC.

PROCEDURES FOR THE DETERMINATION OF
COEFFICIENT OF PERMEABILITY
FOR
GLACIAL AND POST-GLACIAL SOIL DEPOSITS
CLAYEY SILTS, SILTY CLAYS AND CLAYS (ML/CL, CL, CL/CH, CH)

Undistrubed specimens. Permeability (hydraulic conductivity) tests are performed in a triaxial compression chamber utilizing its back-pressure capabilities for saturating the specimens for about 24 hours prior to conducting the tests. The normal procedure is to saturate the specimens under a confining pressure of about 20 psi and a hydraulic head of about 10 to 15 psi, depending upon the sample depth below the groundsurface. The triaxial/permeability set-up and pressures are maintained until the rate of flow is relatively constant before starting a series of several flow measurements made over a period of time.

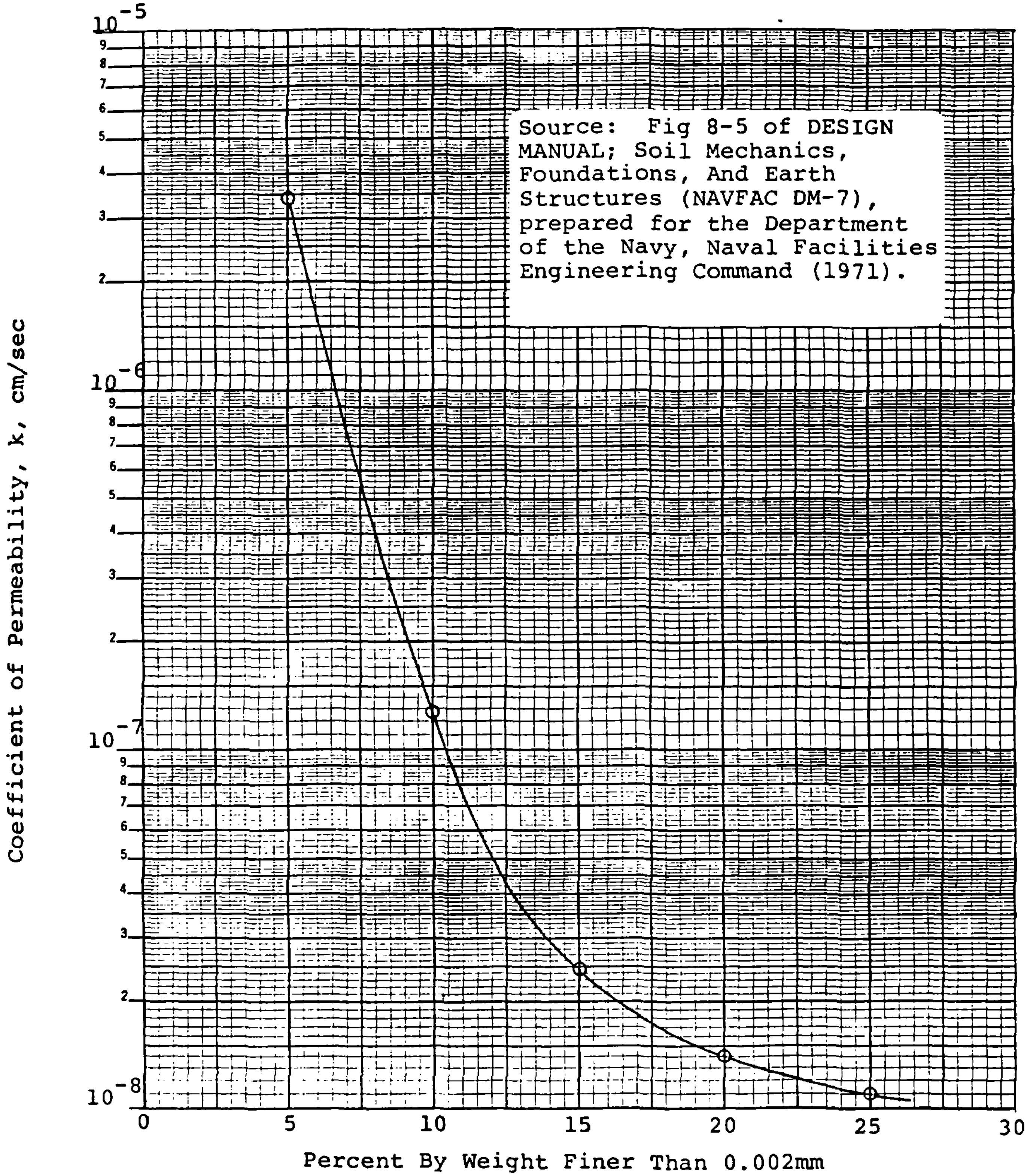
Remolded specimens. When undisturbed specimens can not be obtained, silty-and clay-based soils are remolded and compacted to their approximate original in-situ density, or to a specified percentage of their maximum standard/modified Proctor dry density, in a Harvard miniature compaction apparatus and are then tested in the same manner as undisturbed specimens.

Silts and Silty/Clayey Sands (ML, SM, SC). Because it is generally impossible or impractical to obtain undisturbed samples of, or to remold, coarse-grained soils, the coefficient of permeability may be estimated from grain-size data. Of several emperical methods available, that given in the DESIGN MANUAL; Soil Mechanics, Foundations, and Earth Structures (NAVFAC DM-7) as prepared for the Department of the Navy, Naval Facilities Engineering Command (1971) is considered to be the most accurate because it is based on the percent by weight of fines (silt, clay, other fines) passing the No. 200 Standard Sieve. The attached diagram shows the effect of clay-size (particle size less than 0.002 mm) particles on the coefficient of permeability.

The permeability of clean, well/poorly-graded sands may also be estimated from one of several reliable grain-size procedures, or from field testing.

Appendix 2. Monitoring Well Construction Summary. Cabot Corporation, Tuscola, Illinois. (All measurements in feet below ground surface unless otherwise noted. Elevation in feet above plant reference datum and height of casing in feet above grade.)

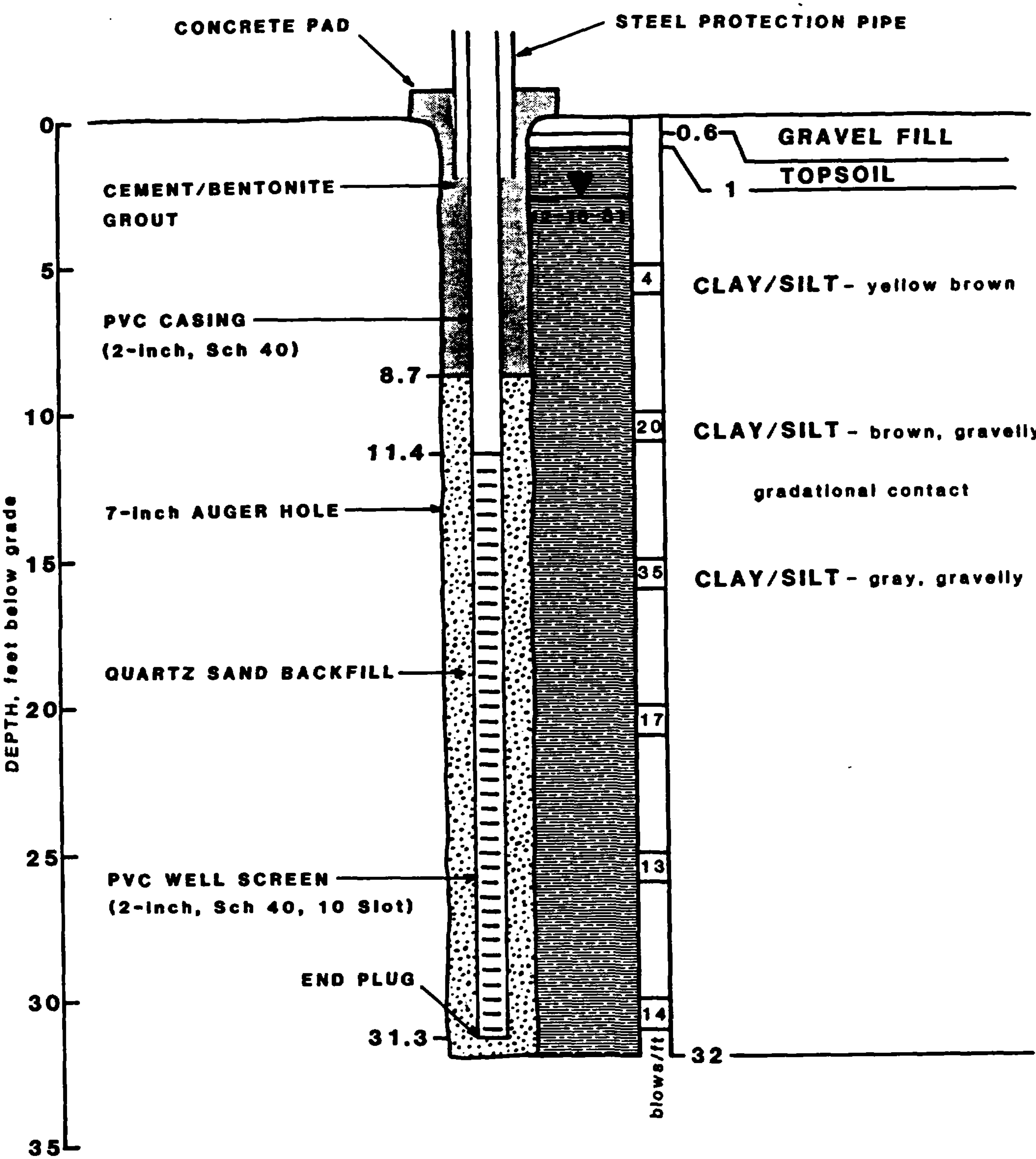
				Measuring Point			
Well	Size	Total Depth	Screened Interval	M.P.	Elev.	Height	Installed
	(in)	(ft)	(ft)	(ft)	(ft)	(ft)	
MW-1	2	31.3	11.4 - 31.3	TOC	125.79	3.0	12-7-81
MW-2	2	31.4	11.4 - 31.4	TOC	123.03	3.0	12-7-81
MW-3	2	29.8	10.0 - 29.8	TOC	119.25	3.0	12-8-81
MW-4	2	30.5	10.6 - 30.5	TOC	123.22	3.0	12-8-81



EFFECT OF CLAY-SIZE PARTICLES
ON PERMEABILITY

APPENDIX 3

Well Construction Diagrams



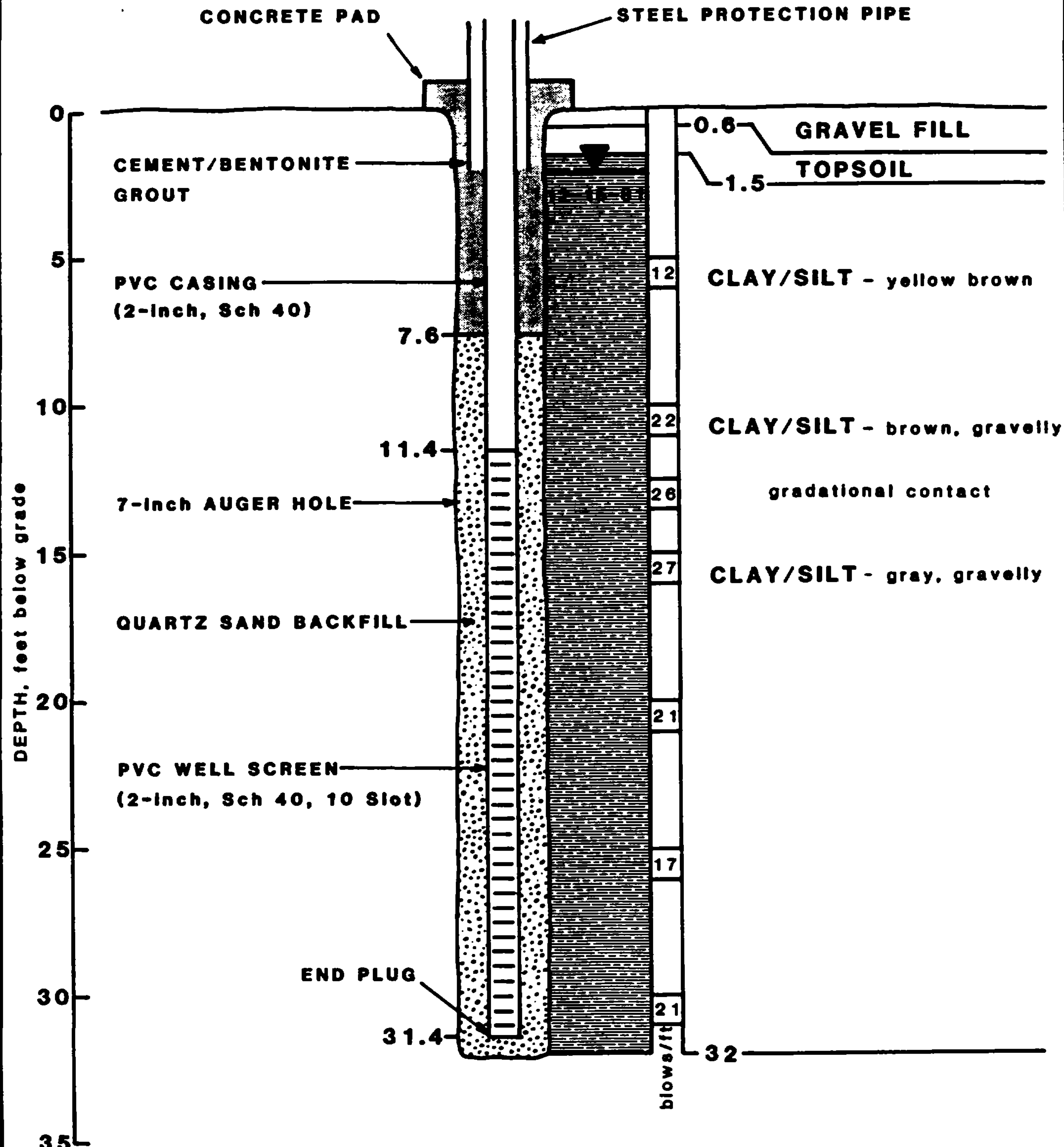
NOTES:

1) Installed 12-7-81
2) Flush threaded joints
3) TOC elevation
4) TOC is 3.0 ft above grade

APPENDIX 2

MW-1 CONSTRUCTION DIAGRAM

CABOT CORPORATION
TUSCOLA, ILLINOIS



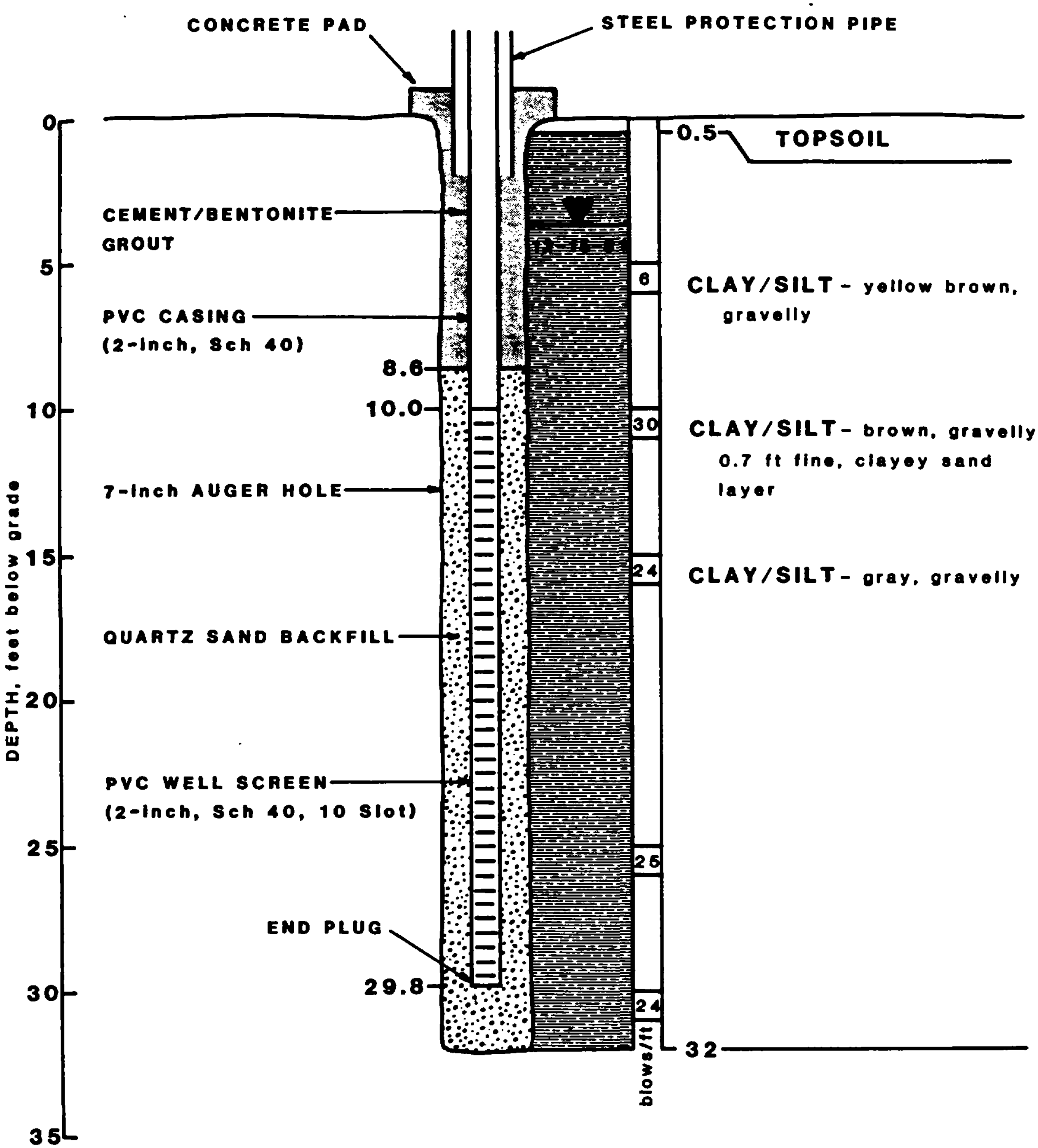
NOTES:

1) Installed 12-7-81
2) Flush threaded joints
3) TOC elevation
4) TOC is 3.0 ft above grade

APPENDIX 2

MW-2 CONSTRUCTION DIAGRAM

CABOT CORPORATION
TUSCOLA, ILLINOIS



NOTES:

1) Installed 12-8-81

2) Flush threaded joints

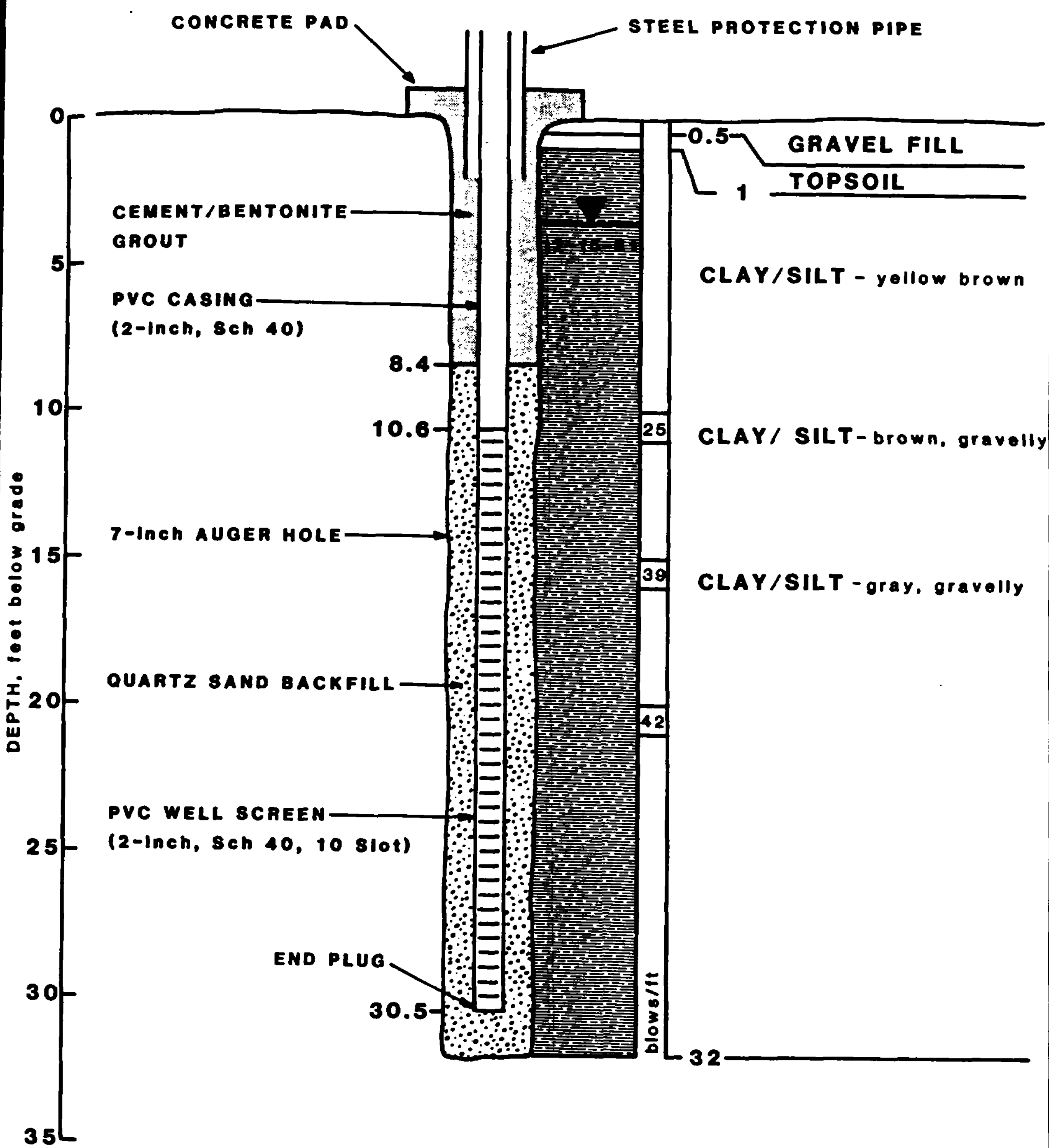
3) TOC elevation

4) TOC is 3.0 feet above grade

APPENDIX 2

MW-3 CONSTRUCTION DIAGRAM

CABOT CORPORATION
TUSCOLA, ILLINOIS



NOTES:

1) Installed 12-8-81
2) Flush threaded joints
3) TOC elevation
4) TOC is 3.0 ft above grade

APPENDIX 2

MW-4 CONSTRUCTION DIAGRAM

CABOT CORPORATION
TUSCOLA, ILLINOIS